



**University of  
Zurich**<sup>UZH</sup>

**Zurich Open Repository and  
Archive**

University of Zurich  
University Library  
Strickhofstrasse 39  
CH-8057 Zurich  
[www.zora.uzh.ch](http://www.zora.uzh.ch)

---

Year: 2018

---

## **Examination of sun-induced fluorescence (SIF) signal on heterogeneous ecosystem platforms using ‘HyPlant’**

Bandopadhyay, Subhajit ; Rastogi, Anshu ; Juszczak, Radosław ; Rademske, Patrick ; Schickling, Anke ; Cogliati, Sergio ; Julitta, Tommaso ; Mac Arthur, Alasdair ; Hueni, Andreas ; Tomelleri, Enrico ; Stróżecki, Marcin ; Gabka, Maciej ; Sojka, Mariusz ; Iordache, Marian-Daniel ; Reusen, Ils ; Damm, Alexander ; Schuettemeyer, Dirk ; Rascher, Uwe

Posted at the Zurich Open Repository and Archive, University of Zurich

ZORA URL: <https://doi.org/10.5167/uzh-152162>

Conference or Workshop Item

Published Version



The following work is licensed under a Creative Commons: Attribution 4.0 International (CC BY 4.0) License.

Originally published at:

Bandopadhyay, Subhajit; Rastogi, Anshu; Juszczak, Radosław; Rademske, Patrick; Schickling, Anke; Cogliati, Sergio; Julitta, Tommaso; Mac Arthur, Alasdair; Hueni, Andreas; Tomelleri, Enrico; Stróżecki, Marcin; Gabka, Maciej; Sojka, Mariusz; Iordache, Marian-Daniel; Reusen, Ils; Damm, Alexander; Schuettemeyer, Dirk; Rascher, Uwe (2018). Examination of sun-induced fluorescence (SIF) signal on heterogeneous ecosystem platforms using ‘HyPlant’. In: EGU General Assembly 2018, Vienna, 8 April 2018 - 13 April 2018, Copernicus Publications.



## Examination of Sun-induced Fluorescence (SIF) Signal on Heterogeneous Ecosystem Platforms using ‘HyPlant’

Subhajit Bandopadhyay (1), Anshu Rastogi (1), Radosław Juszczak (1), Patrick Rademske (2), Anke Schickling (2), Sergio Cogliati (3), Tommaso Julitta (3), Alasdair Mac Arthur (4), Andreas Hueni (5), Enrico Tomelleri (6), Marcin Stróżecki (1), Maciej Gąbka (7), Mariusz Sojka (8), Marian-Daniel Iordache (9), Ils Reusen (9), Alex Damm (10), Dirk Schuettemeyer (11), and Uwe Rascher (2)

(1) Poznan University of Life Sciences, Faculty of Environmental Engineering and Spatial Management, Department of Meteorology, Poland (subhajit.iirs@gmail.com), (2) Forschungszentrum Juelich GmbH, Institute of Biogeosciences, IBG2; Juelich, Germany, (3) University of Milano-Bicocca, Department of Earth and Environmental Sciences; Milano, Italy, (4) School of Geosciences, University of Edinburgh; Edinburgh, UK, (5) University of Zurich; Zurich, Switzerland, (6) Faculty of Science and Technology, Free University of Bolzano/Bozen, Italy, (7) Adam Mickiewicz University; Poznan, Poland, (8) Poznań University of Life Sciences, Department of Land Improvement, Env. Development and Geodesy, (9) Center for Remote Sensing and Earth Observation Processes (VITO-TAP), Belgium, (10) Department of Geography, University of Zurich; Zurich, Switzerland, (11) European Space Agency, ESTEC; Noordwijk, The Netherlands

From the past decades, many satellite missions are continuously monitoring the global biospheric activity. Assessment and monitoring of terrestrial photosynthetic function on a global scale still remain uncertain after plenty of EO missions. It is difficult to quantify the actual photosynthetic rate on the basis of the simple greenness of vegetation using optical remote sensing technology. Measurement of Sun-induced chlorophyll Fluorescence (SIF) emitted by the terrestrial vegetation using airborne-based imaging spectroscopy, provide us a straight opportunity to track the variations of photosynthetic efficiency and monitor the plant health condition. Presently, chlorophyll SIF signal is a very timely topic and a subject of interest for the remote sensing scientific communities and space agencies, such as ESA (European Space Agency) and NASA (National Aeronautics and Space Administration).

Here we compute and analyze the SIF signals coming from different ecosystems i.e. grassland, harvested land, forest, young forest, deforestation area, aquatic region, and heterogeneous area of non-degraded peatland in Poland using new airborne-based imaging spectrometer ‘HyPlant’ (the airborne demonstrator for the FLEX mission) datasets. The FLuorescence EXplorer (FLEX) is the first satellite mission to be designed specifically for the measurement of passive sun-induced chlorophyll fluorescence in the terrestrial ecosystem. ‘HyPlant’ had been operated and captured data during SWAMP campaign on 11th of July 2015 supported by ESA within the FLEX-EU project, COST Action OPTIMISE, and EUFAR.

According to the existing literature on SIF measurement, till date, most of the studies are focusing on some specific ecosystems like cropland, grassland, or the forest area. In this study, we have emphasized on a comparative analysis of SIF signals obtained from different managed and natural ecosystems as well as different plant communities of peatland vegetation in a particular seasonal setting.

Spectral Fitting Method (SFM) retrieval algorithm which is based on two oxygen absorption bands,  $O_2A$  (740nm) and  $O_2B$  (690nm) was used to obtain the SIF maps of the different SWAMP area. The algorithm only used the high spectral resolution imagery detected by the HyPlant FLUO sensor (670-800 nm). Additionally, the different vegetation indices in relation to Photochemical quenching (PQ) process- NDVI, NDVI<sub>re</sub>, EVI, SR, MTCI, and Non-photochemical quenching (NPQ) process- PRI, cPRI has been calculated and analyzed. The outcome reveals a high to low SIF signal from grassland, young forest, forest and shallow aquatic ecosystems respectively, however, grassland was reflecting high MTCI, NDVI, NDVI<sub>re</sub>, EVI, and SR values. The high values of PRI and cPRI come from peatland domain. Aquatic and deforested regions showed low values for all indices. To bridge the gap in between in-situ measurements and classical remote sensing, we validate the SIF signals and vegetation indices calculated from ‘HyPlant’ data with the ground measurements during the same time frame.

### Acknowledgment

The Research was co-funded by the COST Action ES1309 OPTIMISE, FP7 European Facility for Airborne Research (EUFAR), FLEX-EU ESA (Contract No. 4000107143/12/NL/FF/If CCN3) and European Space Agency which supported the SWAMP training course and airborne campaigns on 11th of July 2015. Analyses of the data were supported by the Polish National Research Centre within the project No 2016/21/B/ST10/02271

